



General

Guideline Title

Incentive spirometry: 2011.

Bibliographic Source(s)

Restrepo RD, Wettstein R, Wittnebel L, Tracy M. AARC clinical practice guideline: incentive spirometry: 2011. *Respir Care*. 2011 Oct;56(10):1600-4. [54 references] [PubMed](#)

Guideline Status

This is the current release of the guideline.

This guideline updates a previous version: American Association for Respiratory Care (AARC). AARC clinical practice guideline. Incentive spirometry. *Respir Care* 1991 Dec;36(12):1402-5.

Recommendations

Major Recommendations

The levels of evidence (A-D) and the strength of the recommendations (1-2) are defined at the end of the "Major Recommendations" field. The words "recommended" and "suggested" are used to reflect the strength of the recommendation, as level 1 and level 2, respectively.

Procedure

Incentive spirometry, also referred to as sustained maximal inspiration, is accomplished by using a device that provides feedback when the patient inhales at a predetermined flow or volume and sustains the inflation for at least 5 seconds. The patient is instructed to hold the spirometer in an upright position, exhale normally, and then place the lips tightly around the mouthpiece. The next step is a slow inhalation to raise the ball (flow-oriented) or the piston/plate (volume-oriented) in the chamber to the set target. At maximum inhalation, the mouthpiece is removed, followed by a breath-hold and normal exhalation. Instruction of parents, guardians, and other health caregivers in the technique of incentive spirometry may help to facilitate the patient's appropriate use of the technique and assist with encouraging adherence to therapy.

Limitations of Method

The usefulness of prophylactic respiratory therapy, including incentive spirometry, for the prevention of clinically relevant postoperative pulmonary complications is controversial.

- The effectiveness of incentive spirometry may depend on patient selection, careful instruction, and supervision during respiratory training.
 - Inadequate training and insufficient self-administration of incentive spirometry may result in lack of resolution of postoperative

complications (Christensen et al., 1991).

- Evidence strongly suggests that incentive spirometry alone may be inappropriate to prevent or treat postoperative complications (Schwieger et al., 1986; Hall et al., 1991; Melendez et al., 1992).
- Respiratory therapy, with or without incentive spirometry, may have similar clinical outcomes.
 - Preoperative and postoperative respiratory therapy that includes deep breathing exercises, directed cough, early mobilization, and optimal analgesia (Ballantyne et al., 1998; Desai, 1999; Winters, 2009), with or without incentive spirometry, appears to be effective in preventing or reversing complications after thoracic surgery (Weiner et al., 1997; Agostini et al., 2008; Agostini & Singh, 2009; Gosselink et al., 2000; Varela et al., 2006), cardiac surgery (Pasquina, Tramer, & Walder, 2003; Dias et al., 2011; Crowe & Bradley, 1997), abdominal surgery (Mang & Kacmarek, 1991; Hall et al., 1996; Thomas & McIntosh, 1994; Pasquina et al., 2006; Guimarães et al., 2009; Bapoje et al., 2007; Overend et al., 2001), and peripheral surgery in obese adults (Zoremba et al., 2009).
 - Evidence is lacking for benefit of incentive spirometry in reducing pulmonary complications and in decreasing the negative effects on pulmonary function in patients undergoing coronary artery bypass graft surgery (Overend et al., 2001; Westerdahl et al., 2005; Freitas et al., 2007; Romanini et al., 2007; Renault et al., 2009).
 - Incentive spirometry has not been associated with significant improvements of inspiratory capacity prior to laparoscopic bariatric surgery and may not be useful to prevent postoperative decrease in lung function (Cattano et al., 2010; Kundra et al., 2010).
 - There is no significant difference between deep breathing with directed cough and incentive spirometry in the prevention of postoperative pulmonary complications following esophagectomy (Vats, 2009).
 - In patients with neuromuscular disease, incentive spirometry may not be as effective as intrapulmonary percussion ventilation in preventing atelectasis (Reardon et al., 2005).

Settings

- Critical care
- Acute care in-patient
- Extended care and skilled nursing facility
- Home care

Indications

- Preoperative screening of patients at risk for post-operative complications to obtain baseline flow or volume (Agostini et al., 2008; Kips, 1997; Larson et al., 2009).
- Respiratory therapy that includes daily sessions of incentive spirometry plus deep breathing exercises, directed coughing, early ambulation, and optimal analgesia may lower the incidence of postoperative pulmonary complications.
- Presence of pulmonary atelectasis or conditions predisposing to the development of pulmonary atelectasis when used with:
 - Upper-abdominal or thoracic surgery (Westwood et al., 2007)
 - Lower-abdominal surgery (Pappachen et al., 2006)
 - Prolonged bed rest
 - Surgery in patients with chronic obstructive pulmonary disease (COPD)
 - Lack of pain control (Bellet et al., 1995)
 - Presence of thoracic or abdominal binders
 - Restrictive lung defect associated with a dysfunctional diaphragm or involving the respiratory musculature
 - Patients with inspiratory capacity 2.5 L (Weindler & Kiefer, 2001)
 - Patients with neuromuscular disease
 - Patients with spinal cord injury (Chureemas & Kovindha, 1992)
- Incentive spirometry may prevent atelectasis associated with the acute chest syndrome in patients with sickle cell disease (Bellet et al., 1995; Hsu, Batts, & Rau, 2005).
- In patients undergoing coronary artery bypass graft (Yáñez-Brage et al., 2009)
 - Incentive spirometry and positive airway pressure therapy may improve pulmonary function and 6-minute walk distance and reduce the incidence of postoperative complications (Haeflener et al., 2008; Ferreira et al., 2010).

Contraindications

- Patients who cannot be instructed or supervised to assure appropriate use of the device
- Patients in whom cooperation is absent or patients unable to understand or demonstrate proper use of the device
 - Very young patients and others with developmental delays
 - Patients who are confused or delirious

- Patients who are heavily sedated or comatose
- Incentive spirometry is contraindicated in patients unable to deep breathe effectively due to pain, diaphragmatic dysfunction, or opiate analgesia. (Wilkins, 2005)
- Patients unable to generate adequate inspiration with a vital capacity <10 mL/kg or an inspiratory capacity <33% of predicted normal (Wilkins, 2005)

Hazards and Complications

- Ineffective unless performed as instructed
- Hyperventilation/respiratory alkalosis
- Hypoxemia secondary to interruption of prescribed oxygen therapy
- Fatigue
- Pain

Assessment of Need

- Surgical procedure involving abdomen or thorax
- Conditions predisposing to development of atelectasis, including immobility and abdominal binders

Assessment of Outcomes

- Resolution or improvement in signs of atelectasis
 - Decreased respiratory rate
 - Absence of fever
 - Normal pulse rate
 - Improvement in previously absent or diminished breath sounds
 - Improved radiographic findings
 - Improved arterial oxygen tension (partial pressure of oxygen in arterial blood [P_{aO_2}], saturation of oxygen in arterial blood [S_{aO_2}], pulse oximeter oxygen saturation [S_{pO_2}], reduced fraction of inspired oxygen [F_{IO_2}] requirement)

Resources

- Equipment
 - Volume-oriented incentive spirometer
 - Volume-oriented incentive spirometers are frequently associated with lower imposed work of breathing and larger inspiratory lung volume than flow-oriented incentive spirometers (Weindler & Kiefer, 2001; Parreira et al., 2005; Mang, Obermayer, & Weindler, 1988; Ho et al., 2000; Yamaguti et al., 2010).
 - Incentive spirometers with a low additional imposed work of breathing might be more suitable for postoperative respiratory training (Weindler & Kiefer, 2001).
 - Flow-oriented incentive spirometer
- Personnel
 - Clinical personnel should possess:
 - Ability to implement standard/universal precautions
 - Mastery of techniques for proper operation and clinical application of device
 - Ability to instruct patient in proper technique
 - Ability to respond appropriately to adverse effects
 - Ability to identify need for therapy, response to therapy, and need to discontinue ineffective therapy

Monitoring

Direct supervision of every patient use of incentive spirometry is not necessary once the patient has demonstrated mastery of technique. However, intermittent reassessment is essential to optimal performance.

- Observation of patient performance and utilization
 - Frequency of sessions
 - Number of breaths/session
 - Inspiratory volume, flow, and breath hold goals achieved

- Effort/motivation
- Device within reach of patient to encourage performing without supervision

Frequency

Evidence is lacking for a specific frequency for use of incentive spirometry. Some suggestions have been made in clinical trials.

- Ten breaths every one (Rafea et al., 2009) to two (Bellet et al., 1995) hours while awake
- Ten breaths, 5 times a day (Renault et al., 2009)
- Fifteen breaths every 4 hours (Kundra et al., 2010)

After proper instruction and return demonstration, the patient should be encouraged to perform incentive spirometry independently.

Infection Control

- Centers for Disease Control guidelines for standard precautions should be followed.
- All equipment and supplies should be appropriately disposed of or disinfected according to manufacturer recommendations.

Recommendations

The following recommendations are made following the Grading of Recommendations Assessment, Development and Evaluation (GRADE) scoring system (Restrepo, 2010):

1. Incentive spirometry alone is not recommended for routine use in the preoperative and postoperative setting to prevent postoperative pulmonary complications (1B).
2. It is recommended that incentive spirometry be used with deep breathing techniques, directed coughing, early mobilization, and optimal analgesia to prevent postoperative pulmonary complications (1A).
3. It is suggested that deep breathing exercises provide the same benefit as incentive spirometry in the preoperative and postoperative setting to prevent post-operative complications (2C).
4. Routine use of incentive spirometry to prevent atelectasis in patients after upper-abdominal surgery is not recommended (1B).
5. Routine use of incentive spirometry to prevent atelectasis after coronary artery bypass graft surgery is not recommended (1A).
6. It is suggested that a volume-oriented device be selected as an incentive spirometry device (2B).

Definitions:

Strength of the Recommendations and Grade of Quality of the Evidence

Strength of the Recommendations		
Level	Strength	Description
1	Stronger	Benefits clearly outweigh the risks and burdens (or vice versa) for nearly all patients.
2	Weaker	Risks and benefits are more closely balanced or are more uncertain.
Quality of the Evidence		
Grade	Quality	Description
A	High	Well-performed randomized controlled trials or overwhelming evidence of some other sort. Further research is very unlikely to change confidence in the estimate of the effect.
B	Moderate	Randomized controlled trials that are less consistent, have flaws, or are indirect in some way to the issue being graded, or very strong evidence of some other sort. Further research is likely to have an important impact on confidence in the estimate of effect and may change the estimate.
C	Low	Observational evidence (from observational studies, case series, or clinical experience), or evidence from controlled trials with serious flaws. Further research is very likely to have an important impact on confidence in the estimate of effect and is likely to change the estimate.
D	Very Low	Any estimate of effect is very uncertain.

Adapted from: Guyatt GH, Oxman AD, Vist GE, Kunz R, Falck-Ytter Y, Alonso-Coello P, Schünemann HJ; GRADE Working Group. GRADE: an emerging consensus on rating quality of evidence and strength of recommendations. BMJ 2008;336(7650):924-926.

Clinical Algorithm(s)

None provided

Scope

Disease/Condition(s)

Postoperative pulmonary complications, including atelectasis, pneumonia, and respiratory failure

Note: Refer to the "Indications" section in the "Major Recommendations" field of this summary for specific diseases and conditions.

Guideline Category

Evaluation

Management

Prevention

Clinical Specialty

Critical Care

Geriatrics

Internal Medicine

Pediatrics

Pulmonary Medicine

Surgery

Thoracic Surgery

Intended Users

Advanced Practice Nurses

Allied Health Personnel

Nurses

Physician Assistants

Physicians

Respiratory Care Practitioners

Guideline Objective(s)

To provide clinical practice guidelines on incentive spirometry

Target Population

Patients at risk for postoperative pulmonary complications (i.e., patients undergoing surgical procedures involving the abdomen or thorax and patients with conditions predisposing to development of atelectasis, including immobility and abdominal binders)

Interventions and Practices Considered

1. Preoperative screening of patients at risk for postoperative complications to obtain baseline flow or volume
2. Assessment of need for incentive spirometry
3. Assessment of outcome (resolution or improvement in signs of atelectasis)
4. Equipment and personnel requirements
5. Monitoring of patient performance
6. Frequency of use
7. Infection control
8. Use of concomitant respiratory therapy (e.g., deep breathing techniques, directed coughing), early mobilization, and optimal analgesia

Note: Incentive spirometry alone is not recommended for routine use in the preoperative and postoperative setting to prevent postoperative pulmonary complications.

Major Outcomes Considered

- Prevention or reversal of postoperative pulmonary complications
- Improvement in inspiratory capacity and pulmonary function

Methodology

Methods Used to Collect/Select the Evidence

Searches of Electronic Databases

Description of Methods Used to Collect/Select the Evidence

Searches were conducted of the MEDLINE, CINAHL, and Cochrane Library databases for articles published between January 1995 and April 2011.

Number of Source Documents

The update of this clinical practice guideline is the result of reviewing a total of 54 clinical trials and systematic reviews on incentive spirometry.

Methods Used to Assess the Quality and Strength of the Evidence

Weighting According to a Rating Scheme (Scheme Given)

Rating Scheme for the Strength of the Evidence

Grade of Quality of the Evidence

Grade	Quality	Description
A	High	Well-performed randomized controlled trials or overwhelming evidence of some other sort. Further research is very unlikely to change confidence in the estimate of the effect.
B	Moderate	Randomized controlled trials that are less consistent, have flaws, or are indirect in some way to the issue being graded, or very strong evidence of some other sort. Further research is likely to have an important impact on confidence in the estimate of effect and may change the estimate.
C	Low	Observational evidence (from observational studies, case series, or clinical experience), or evidence from controlled trials with serious flaws. Further research is very likely to have an important impact on confidence in the estimate of effect and is likely to change the estimate.
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Adapted from: Guyatt GH, Oxman AD, Vist GE, Kunz R, Falck-Ytter Y, Alonso-Coello P, Schünemann HJ; GRADE Working Group. GRADE: an emerging consensus on rating quality of evidence and strength of recommendations. *BMJ* 2008;336(7650):924-926.

Methods Used to Analyze the Evidence

Systematic Review

Description of the Methods Used to Analyze the Evidence

The American Association for Respiratory Care (AARC) clinical practice guidelines (CPGs) steering committee has initiated a new process by which the "reference-based" guidelines will be revised and updated by adopting a modification of the Grading of Recommendations Assessment, Development and Evaluation (GRADE) scoring system (see the "Availability of Companion Documents" field). This guideline is the product of this process. Although it is clear that most treatments and interventions in respiratory care are rarely graded A, it is our responsibility to make recommendations based on the best evidence available at the time the CPG is updated. The words "recommended" and "suggested" are used to reflect the strength of the recommendation, as level 1 and level 2, respectively (see the "Rating Scheme for the Strength of the Recommendations" field). Although grading evidence is complex, the committee has set the goal of recommending what you, the clinician, should do. While the format for most traditional sections of the CPGs remains unchanged, each newly revised CPG includes recommendations with graded evidence. This is the latest in our efforts to improve the value of the AARC CPGs.

Methods Used to Formulate the Recommendations

Expert Consensus

Description of Methods Used to Formulate the Recommendations

The recommendations are made following the Grading of Recommendations Assessment, Development, and Evaluation (GRADE) scoring system.

Rating Scheme for the Strength of the Recommendations

Strength of the Recommendations

Level	Strength	Description
1	Stronger	Benefits clearly outweigh the risks and burdens (or vice versa) for nearly all patients.
2	Weaker	Risks and benefits are more closely balanced or are more uncertain.

Adapted from: Guyatt GH, Oxman AD, Vist GE, Kunz R, Falck-Ytter Y, Alonso-Coello P, Schünemann HJ; GRADE Working Group. GRADE: an emerging consensus on rating quality of evidence and strength of recommendations. *BMJ* 2008;336(7650):924-926.

Cost Analysis

A formal cost analysis was not performed and published cost analyses were not reviewed.

Method of Guideline Validation

Not stated

Description of Method of Guideline Validation

Not applicable

Evidence Supporting the Recommendations

References Supporting the Recommendations

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Type of Evidence Supporting the Recommendations

The type of supporting evidence is identified and graded for selected recommendations (see the "Major Recommendations" field).

Benefits/Harms of Implementing the Guideline Recommendations

Potential Benefits

Respiratory therapy that includes daily sessions of incentive spirometry plus deep breathing exercises, directed coughing, early ambulation, and optimal analgesia may lower the incidence of postoperative pulmonary complications.

Potential Harms

Hazards and Complications of Incentive Spirometry

- Ineffective unless performed as instructed
- Hyperventilation/respiratory alkalosis
- Hypoxemia secondary to interruption of prescribed oxygen therapy
- Fatigue
- Pain

Contraindications

Contraindications

- Patients who cannot be instructed or supervised to assure appropriate use of the device
- Patients in whom cooperation is absent or patients unable to understand or demonstrate proper use of the device
 - Very young patients and others with developmental delays
 - Patients who are confused or delirious
 - Patients who are heavily sedated or comatose
- Incentive spirometry is contraindicated in patients unable to deep breathe effectively due to pain, diaphragmatic dysfunction, or opiate analgesia.
- Patients unable to generate adequate inspiration with a vital capacity <10 mL/kg or an inspiratory capacity <33% of predicted normal

Implementation of the Guideline

Description of Implementation Strategy

An implementation strategy was not provided.

Institute of Medicine (IOM) National Healthcare Quality Report Categories

IOM Care Need

Getting Better

Staying Healthy

IOM Domain

Effectiveness

Patient-centeredness

Identifying Information and Availability

Bibliographic Source(s)

Restrepo RD, Wettstein R, Wittnebel L, Tracy M. AARC clinical practice guideline: incentive spirometry: 2011. *Respir Care*. 2011 Oct;56(10):1600-4. [54 references] [PubMed](#)

Adaptation

Not applicable: The guideline was not adapted from another source.

Date Released

1991 (revised 2011 Oct)

Guideline Developer(s)

American Association for Respiratory Care - Professional Association

Source(s) of Funding

American Association for Respiratory Care (AARC)

Guideline Committee

American Association for Respiratory Care Clinical Practice Guidelines Steering Committee

Composition of Group That Authored the Guideline

Committee Members: Ruben D Restrepo MD RRT FAARC (*Chair*), Department of Respiratory Care, University of Texas Health Sciences Center at San Antonio, San Antonio, Texas; Richard Wettstein MMed RRT, University of Texas Health Sciences Center at San Antonio, San Antonio, Texas; Leo Wittnebel MSIS RRT, University of Texas Health Sciences Center at San Antonio, San Antonio, Texas; Michael Tracy RRT-NPS RPFT, Rainbow Babies and Children's Hospital, Cleveland, Ohio

Financial Disclosures/Conflicts of Interest

The authors have disclosed no conflicts of interest.

Guideline Status

This is the current release of the guideline.

This guideline updates a previous version: American Association for Respiratory Care (AARC). AARC clinical practice guideline. Incentive spirometry. *Respir Care* 1991 Dec;36(12):1402-5.

Guideline Availability

Electronic copies: Available in Portable Document Format (PDF) from the [American Association for Respiratory Care \(AARC\) Web site](#) .

Print copies: Available from AARC, 9425 N. MacArthur Blvd., Ste. 100, Irving, TX 75063.

Availability of Companion Documents

The following is available:

- Restrepo RD. American Association for Respiratory Care (AARC) clinical practice guidelines: from "reference-based" to "evidence-based." Respir Care. 2010 Jun;55(6):787-9. Available in Portable Document Format (PDF) from the [American Association for Respiratory Care \(AARC\) Web site](#) .

Print copies: Available from AARC, 9425 N. MacArthur Blvd., Ste. 100, Irving, TX 75063.

Patient Resources

None available

NGC Status

This summary was completed by ECRI on November 30, 1998. The information was verified by the guideline developer on December 15, 1998. This NGC summary was updated by ECRI Institute on February 1, 2012.

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